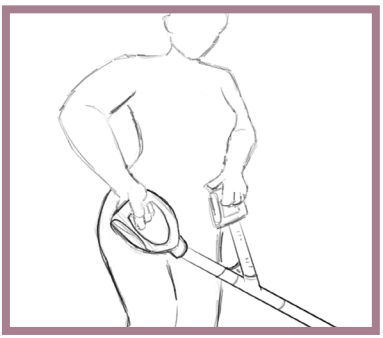
Ergonomics in Hand Tools: Shovels and Pitchforks for Women Farmers

Enhancing Comfort and Reducing Strain.

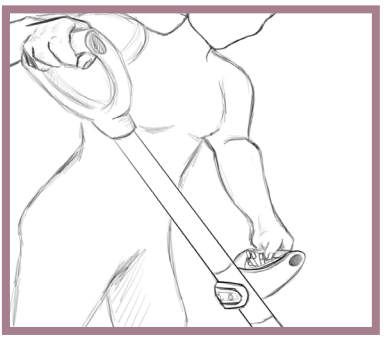
Ergonomics in Hand Tools: Shovels and Pitchforks

Why Ergonomics?

- **Reduces Muscle Fatigue:** Ergonomically designed tools help minimize muscle strain.
- **Increases Productivity:** Comfortable tools enhance efficiency.
- **Prevents Injuries:** Properly designed tools reduce the risk of musculoskeletal disorders (MSDs).



EAHA ergonomic handle



EAHB ergonomic handle

Conventional handle

Health and Safety in Agriculture: Ergonomic Shoveling and Pitchforking for Women Farmers

Introduction:

The proper use of ergonomic tools including shovels and pitchforks can significantly reduce the risk of musculoskeletal disorders (MSDs), improve efficiency, and lower health-related costs for women farmers.

This guide provides practical advice on selecting, adjusting, and using these tools to maximize benefits and minimize physical strain.

Maximizing Benefits and Minimizing Physical Strain

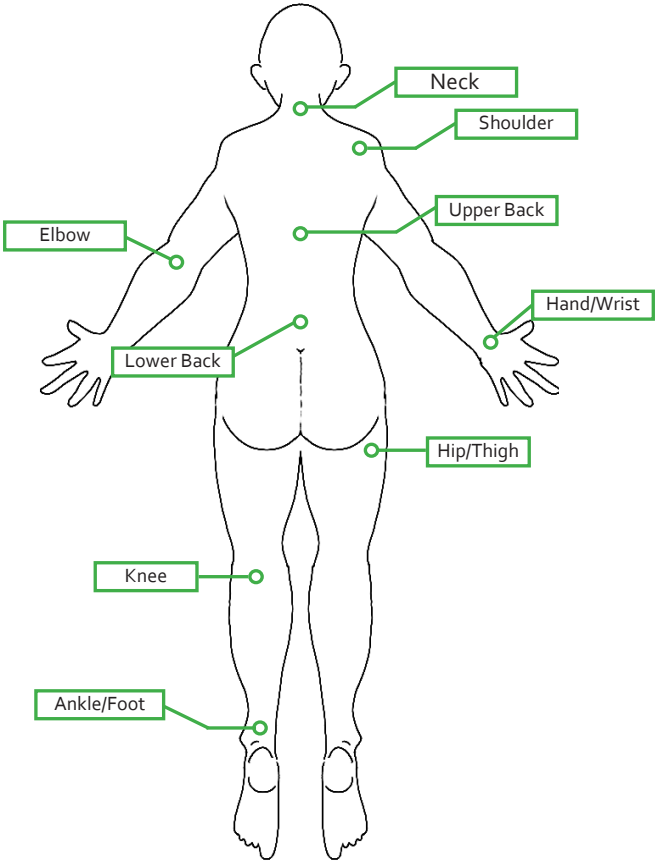
Optimized Tool Selection: Choosing ergonomic tools with the right handle height, lift angle, and grip design reduces physical strain, enhancing comfort and efficiency.

Effective Tool Adjustment: Adjust tools to fit your height and reach, promoting neutral posture and preventing strain, which boosts productivity and reduces the risk of musculoskeletal disorders.

Correct Tool Usage: Proper use of ergonomic tools, such as bending at the knees, keeping loads close, and using leg strength, minimizes strain and prevents injuries, supporting long-term health.

Key Anatomical Regions

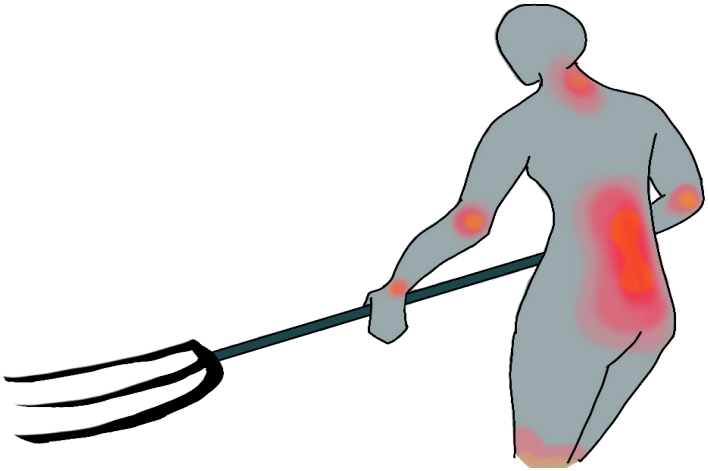
Understanding the key anatomical regions of the human body is essential for effective tool selection, use and ergonomic design. These regions include:



Focusing on these areas helps in tool selection, use and ergonomic design of tools that minimize strain, enhance comfort, and improve overall safety and performance.

Common Areas Affected by MSDs

Neck, Shoulders, Elbows, Wrists, Lower Back strains: These areas are prone to strain and injury.

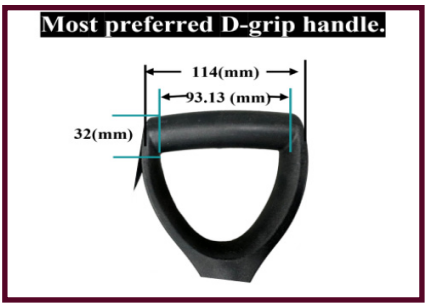


Risk Factors

Inadequate Tool Design, Poor Posture, Lack of Training: These factors increase the risk of upper body pain and injuries.

D-grip Handles in Ergonomic Tool Design

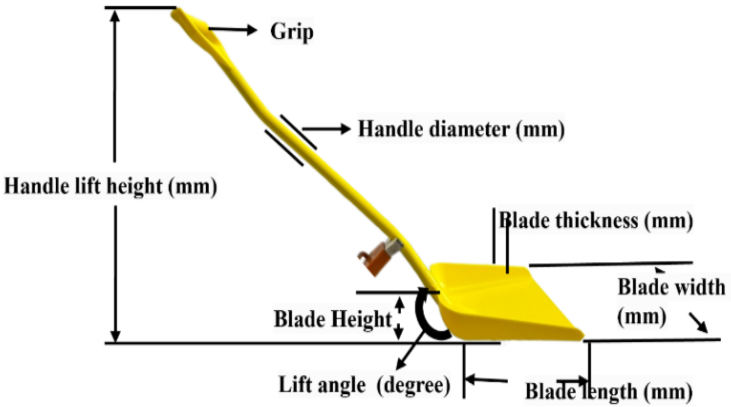
D-grip handles that align with the hand's natural inward curve provide better ergonomic support and are mostly preferred by subjects during experimental studies. This alignment might reduce physical strain.



Key Characteristics of Hand Tools: Lift angle, handle lift height, and weight are critical for ergonomic design.

Illustration of Key Ergonomic Features in a Hand Tool:

Showing the critical measurements including handle lift height, handle diameter, blade dimensions, and lift angle, all essential for reducing physical strain during use.



Ergonomic Design Insights

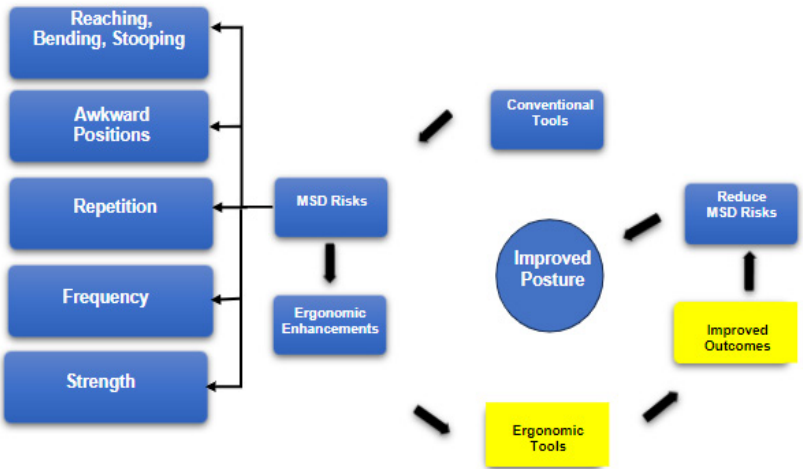
Ergonomic Design: Reduces physical strain and might improve efficiency.

Body Mechanics: Optimal lift angles and handle heights minimize strain.

Critical Factors: Lift angle, handle height, and mechanical advantage are essential for tool effectiveness.

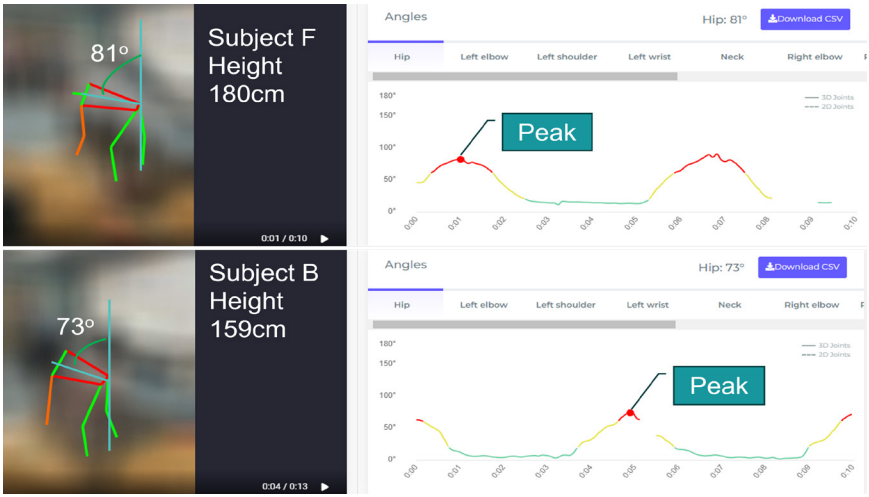
Impact of Ergonomic Enhancements on Posture and Musculoskeletal Disorder (MSD) Risks

This flow map illustrates the critical impact of ergonomic enhancements on posture and the reduction of musculoskeletal disorder (MSD) risks. By improving posture through ergonomic tools/enhancements, the associated risks of repetitive strain and physical discomfort can be significantly minimized, leading to better outcomes for women farmers.



AI-Enhanced Ergonomic Analysis: Optimizing Tool Design for Different User Heights

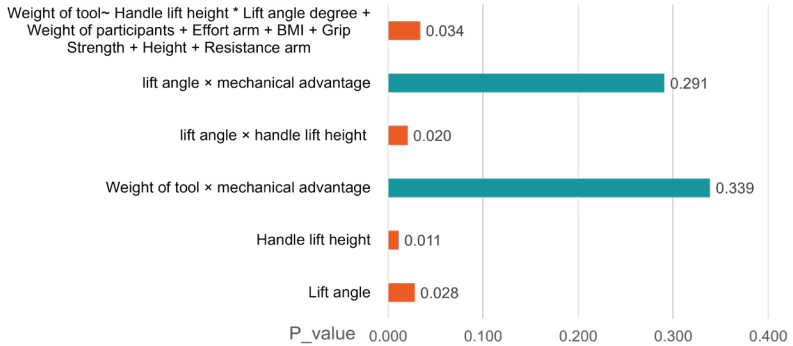
Analyzing the impact of ergonomic tool design on users of different heights, this imagery highlights the importance of proper hand tool accommodation. The graphs demonstrate how optimal angles and peak movements vary with user height, underscoring the need for adjustable ergonomic tools to reduce strain and enhance efficiency."



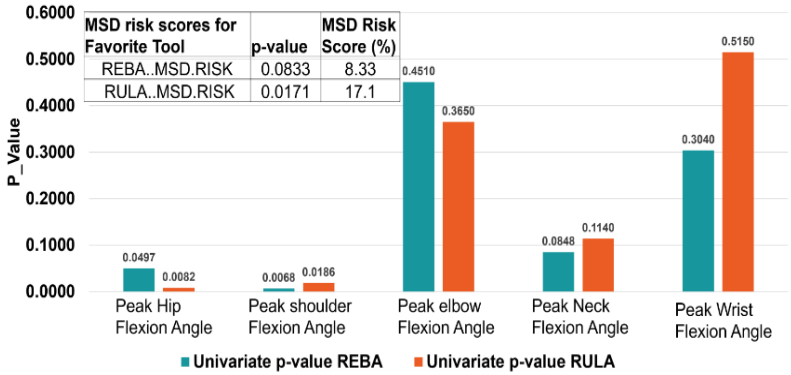
Statistical Findings and Participant Profiles

Participant profiles, including height, weight, and other demographics, informed the ergonomic tool design recommendations by highlighting the diverse needs of women farmers. The statistical analysis of factors like handle height, lift angle, and tool weight demonstrated their critical role in reducing physical strain and preventing musculoskeletal disorders (MSDs). The recommendations provided are based on these findings, ensuring they effectively enhance comfort and efficiency during agricultural tasks.

Data-Driven Design



Various measurements related to ergonomic tool design that reduces musculoskeletal disorder.



MSD risk scores for the favorite tool.

Recommendations for Tool Selection and Use

1. For Farmers and Users:

Buy and use tools with lift angles between 27-49 degrees.

Choose tools with handle heights between 517-984 mm.

Ensure handles are set at a height that allows for a neutral wrist and elbow position.

Use auxiliary handles to distribute the load and reduce strain on the lower back and hips.

Keep your back straight and use your legs to lift.

Rest frequently to avoid fatigue and reduce the risk of repetitive strain injuries.

Perform gentle stretches during breaks to relieve muscle tension.

Utilize wheelbarrows or carts to transport heavy materials, reducing the need for manual lifting.

2. For Manufacturers:

Design tools with lift angles between 27-49 degrees.

Ensure handle heights between 517-984 mm.

Develop tools considering diverse user profiles, including height, weight, and other demographics.

Integrate ergonomic factors that reduce physical strain and enhance efficiency.

Provide adjustable and customizable features to meet individual user needs.

Ergonomic Considerations for Shoveling and Pitchforking

Proper Shoveling and Pitchforking Techniques

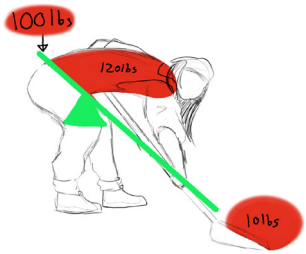
Posture:

Proper

Back Position: Maintain a neutral spine by keeping your back straight and avoiding bending or hunching at the waist.

Knee Use: Bend at the knees rather than the waist to lower yourself to the ground or lift a load.

Load Position: Keep the load close to your body to reduce strain on your back and arms.



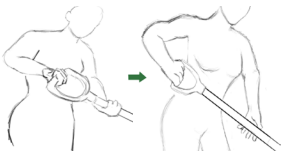
Improper

Back Position: Bending at the waist or hunching over the load, leading to increased strain on the lower back.

Knee Use: Failing to bend at the knees, which forces the back to do all the lifting.

Load Position: Holding the load far from the body, increasing the leverage and strain on the back and arms.

Tool Use:

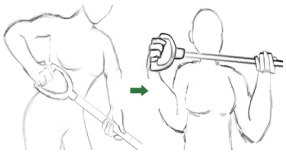


Proper

Handle Adjustment: Use tools with adjustable handles to match your height and avoid excessive reaching or bending.

Grip: Hold the tool with a firm, comfortable grip, keeping your wrists straight to avoid strain.

Rotation: Rotate the tool handle when necessary to maintain an ergonomic wrist position.



Improper

Handle Adjustment: Using tools with fixed handles that do not match the user's height, causing awkward postures.

Grip: Holding the tool with a weak or awkward grip, leading to wrist strain and loss of control.

Rotation: Improperly rotating the tool, causing excessive wrist flexion, extension, or abduction.

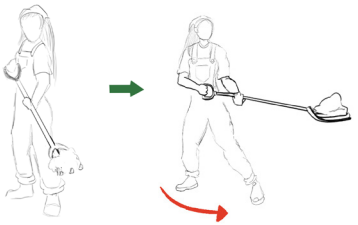
Lifting Technique:

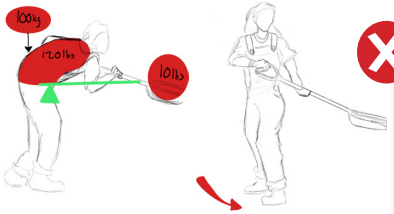
Proper

Legs, Not Back: Use the strength of your legs to lift the load, not your back.

Core Engagement: Tighten your core muscles to support your spine during lifting.

Slow Movements: Lift and lower the load in a controlled manner, avoiding sudden or jerky movements.





Improper

Legs, Not Back: Using the back muscles instead of the legs to lift, leading to increased risk of injury.

Core Engagement: Not engaging the core muscles, leaving the spine unsupported.

Sudden Movements: Lifting or lowering the load quickly and without control, increasing the risk of injury.

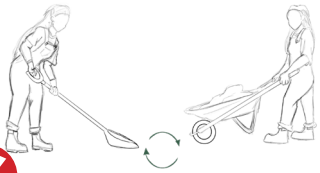
Repetitive Strain Prevention

Proper

Task Rotation: Alternate between different tasks to avoid overusing the same muscle groups.

Breaks: Take frequent short breaks to reduce fatigue and prevent repetitive strain injuries.

Mechanical Aids: Use wheelbarrows or carts to transport heavy materials instead of carrying them.



Improper

Task Rotation: Performing the same task continuously without breaks, leading to overuse injuries.

Breaks: Skipping breaks, leading to increased fatigue and higher risk of repetitive strain injuries.

Mechanical Aids: Manually carrying heavy loads instead of using wheelbarrows or carts.

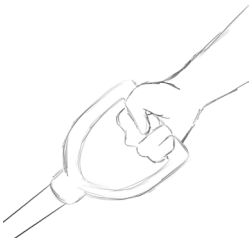
Elbows and Wrists

Proper

Elbow Position: Keep your elbows close to your body to maintain control and reduce strain.

Wrist Alignment: Maintain a neutral wrist angle to avoid flexion and extension, which can lead to strain.

Supination/Pronation: Use proper forearm rotation techniques to minimize strain during lifting and throwing.



Improper

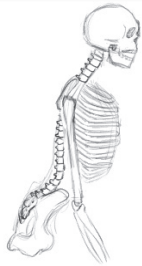
Elbow Position: Keeping elbows away from the body, leading to loss of control and increased strain.

Wrist Alignment: Flexing or extending the wrists excessively, leading to strain and discomfort.

Supination/Pronation: Improper forearm rotation during lifting and throwing, increasing strain on the wrist and forearm muscles.

Comparison of Conventional and Ergonomic Tools

0° - 20°



20° - 60°

60°+

Conventional Tools

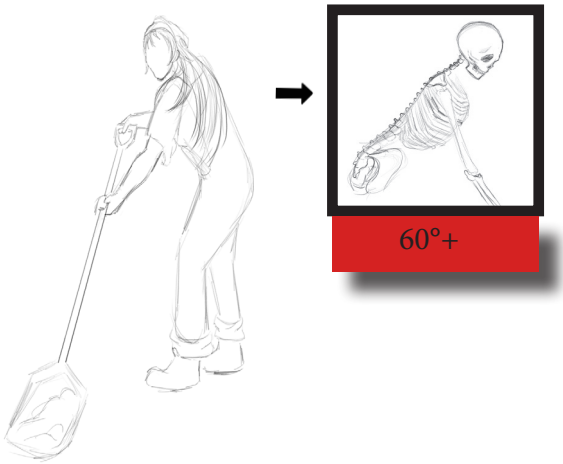
Benefits:

Potential Decrease in Elbow Strain:

- Conventional tools may decrease elbow strain by allowing more flexibility in movement by allowing the hand tool to be rotated in the palm to drop the load.
- This decrease in strain comes as a benefit of being able to rotate the tool in the palm to drop the load with less forceful movement.
- Compared to ergonomically enhanced tools, which require specific positioning for optimal results, conventional tools offer more flexibility in movement, particularly during the throwing of the load.

Challenges:

- Higher risk of wrist strain due to non-ergonomic handle designs. Increased need for a firmer grip, leading to potential flexion and extension issues.
- Greater likelihood of improper wrist alignment during lifting and throwing/release actions.
  Users tend to bend their backs more, increasing overall physical strain.
- Higher cardiovascular and physical strain.
  Increased risk of musculoskeletal disorders due to poor ergonomic design.



Usage Tips:

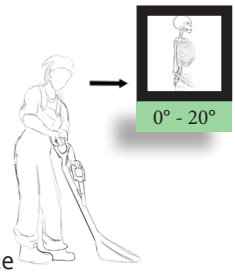
Focus on maintaining proper posture and taking frequent breaks.

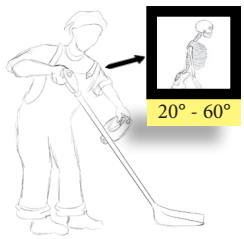
Use mechanical aids whenever possible to reduce strain.

Ergonomic Tools (Improved with Auxiliary Handle):

Benefits:

- Enhanced control and reduced strain due to better handle design.
- Encourages maintenance of neutral wrist position, minimizing flexion and extension issues.
- Supports proper wrist alignment during all actions, reducing the risk of injuries.
- Auxiliary handles help distribute the load and reduce the need for excessive bending.
- Lower heart rate and energy expenditure.
- Reduced hip and wrist strain.
- Improved posture.





Usage Tips:

- Focus on maintaining proper posture and taking frequent breaks.
- Use mechanical aids whenever possible to reduce strain.

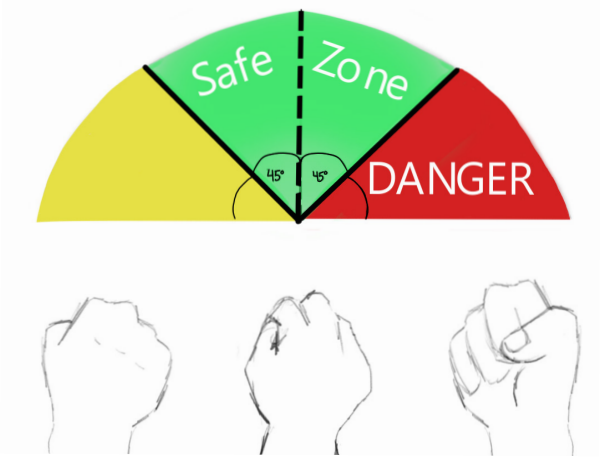
Challenges:

- Trade-off for increased strain on the elbow and shoulder when using ergonomic tools with an auxiliary handle.
- The design of ergonomic tools, particularly the auxiliary handle, requires specific positioning for optimal use.
- This specific positioning can lead to more forceful wrist and elbow movements, potentially resulting in greater strain on these joints.

Usage Tips:

- Adjust handles to fit your body size and comfort.
- Be mindful of elbow strain and adjust your grip as needed.

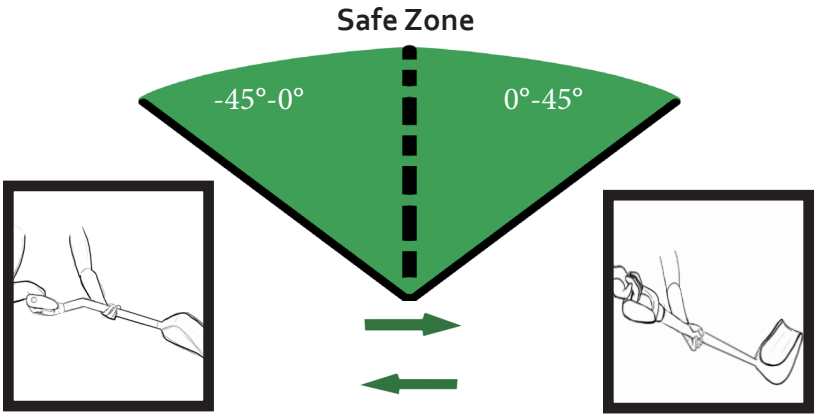
Grip and Forearm Rotation



Placement: Maintain supination (outward rotation) of the wrist close to neutral for better control and less strain.

Lifting: Keep the tool close to neutral supination to maintain control and reduce wrist strain. Use your legs, not your back, for lifting.

Throwing/Release: Avoid excessive pronation (inward rotation) to minimize strain on the wrist and forearm muscles.



By following these guidelines and using ergonomically designed tools, women farmers can significantly reduce the risk of musculoskeletal disorders, improve efficiency, and lower health-related costs. Adopting proper techniques and making thoughtful tool selections are essential steps toward a healthier, more productive farming experience.

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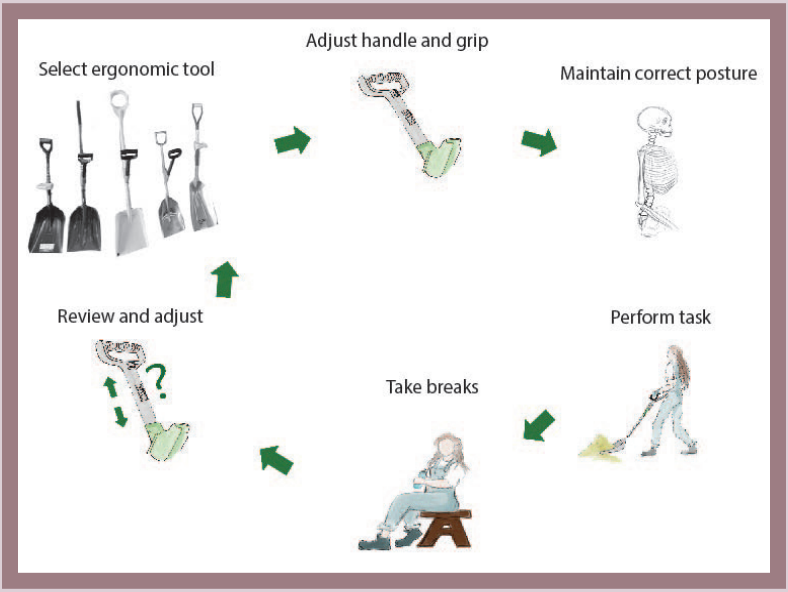

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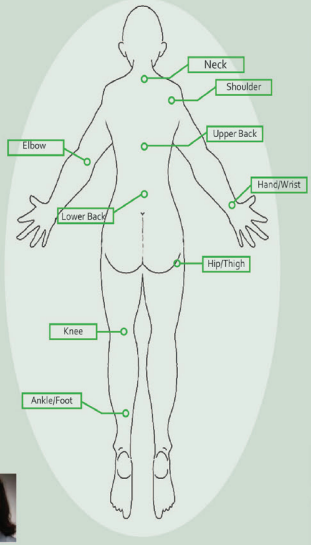
Common Areas Affected by MSDs

Common Symptoms

- Backaches
- Shoulder pain
- Arm and hand discomfort



Practical Solutions

- Adjustable handles
- Ergonomic grips
- Proper lifting techniques

Prevention Tips

- Use ergonomic tools
- Maintain good posture
- Take regular breaks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Dr. Marcia Shannon


Felix Michael Oguche


Puna Neumeier

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